Amendments

In the Claims, kindly replace all prior versions, and listings, of claims in the application with the following:

1. (Currently amended) A method for determining relationships among objects represented in a database, the method comprising the steps of:

receiving a query including at least a first geometry and a desired relationship between the first geometry and a second geometry;

providing the query to a primary filter operable to:

define at least one interior rectangle that lies entirely within the first geometry;

define a minimum bounding rectangle for the first geometry;

define a minimum bounding rectangle for the second geometry; and

compare the minimum bounding rectangle for the first geometry with the minimum bounding rectangle for the second geometry to determine if the second geometry fulfills a primary filter condition comprising an interaction of the first geometry and the second geometry;

if the second geometry fulfills the primary filter condition, providing the first geometry and the second geometry to an intermediate filter operable to:

determine whether the second geometry fulfills an intermediate filter condition comprising an interaction of the at least one interior rectangle within the first geometry and the minimum bounding rectangle for the second geometry by analyzing the distribution of the minimum bounding rectangle for the second geometry with respect to the at least one interior rectangle within the first geometry;

if the second geometry is confirmed as fulfilling the intermediate filter condition, including the second geometry in a final result set of objects that satisfy the desired relationship;

if the second geometry is confirmed as deviating from the intermediate filter condition, excluding the second geometry from the final result set that satisfy the desired relationship;

otherwise, providing the first geometry and the second geometry to a secondary filter operable to:

determine whether the second geometry fulfills a secondary filter condition by comparing the second geometry with the first geometry; and

if the second geometry fulfills the secondary filter condition, including the second geometry in the final result set of objects that satisfy the desired relationship.

2. (Currently amended) The method according to claim 48 ~~1~~, wherein the first geometry ~~comprises a query geometry~~ and the second geometry comprise ~~comprises a~~ data ~~geometry~~ geometries stored in a database.

3. (Currently amended) The method according to claim 48 ~~1~~, wherein the first geometry comprises a data geometry stored in a database and the second geometry comprises a query geometry.

4. (Currently amended) The method according to claim 48 ~~1~~, wherein the first geometry is larger than the second geometry.

5. (Currently amended) The method according to claim 48 ~~1~~, wherein minimum bounding rectangles are defined for a plurality of second geometries.

6. (Currently amended) The method according to claim 48 ~~1~~, wherein the first geometry is a collection of geometries each including a separate interior.

7. (Currently amended) The method according to claim 48 ~~1~~, wherein providing the first geometry and the second geometry to an intermediate filter is in response to the second geometry fulfilling a ~~the~~ primary filter condition ~~comprises~~ comprising any intersection between the minimum bounding rectangle for the first geometry and the minimum bounding rectangle for the second geometry.

8. (Currently amended) The method according to claim 48 ~~1~~, wherein ~~dividing the first geometry into a plurality of interior rectangle~~ defining the at least one interior rectangle that lies entirely within the first geometry comprises:

dividing the minimum bounding rectangle for the first geometry into a plurality of pieces; and

defining a largest possible interior rectangle lying completely within the first geometry and the plurality of pieces ~~each piece~~.

9. (Currently amended) The method according to claim 48 ~~1~~, wherein the plurality of pieces are rectangles.

10. (Currently amended) The method according to claim 9, wherein ~~the minimum bounding rectangle for the first geometry is divided into~~ the plurality of pieces are five rectangles having ~~similar shapes and~~ sizes.

11. (Previously presented) The method according to claim 9, wherein the minimum bounding rectangle for the first geometry is divided into four rectangles having similar ~~shapes and~~ sizes.

12. (Currently amended) The method according to claim 48 ~~1~~, wherein the minimum bounding rectangle of the second geometry comprises a smallest rectangle that at most intersects a boundary of the second geometry.

13. (Currently amended) The method according to claim 48 ~~1~~, wherein the intermediate filter condition is fulfilled if the minimum bounding rectangle of the second geometry lies entirely within the minimum bounding rectangle of the first geometry.

14. (Currently amended) The method according to claim 48 ~~1~~, wherein the primary filter condition is one of ~~includes at least one member selected from the group comprising~~:

the minimum bounding rectangle of the second geometry lies entirely within the minimum bounding rectangle of the first geometry;

the minimum bounding rectangle of the second geometry intersects the minimum bounding rectangle of the first geometry;

a border of the minimum bounding rectangle of the second geometry touches a border of the minimum bounding rectangle of the first geometry;

the minimum bounding rectangle of the first geometry lies entirely within the minimum bounding rectangle of the second geometry; and

the minimum bounding rectangle of the second geometry is disjoint from the minimum bounding rectangle of the ~~query~~ first geometry.

15. (Currently amended) The method according to claim 48 ~~1~~, wherein the first geometry is divided into five interior rectangles.

16. (Currently amended) The method according to claim 48 ~~1~~, wherein one of the first geometry ~~object~~ and the second geometry ~~object comprises~~ comprise ~~an object~~ objects in a database.

17. (Currently amended) The method according to claim 16, wherein the objects in the database comprises locations in a geographic region.

18. (Currently amended) The method according to claim 16, wherein the database is organized in an R-tree hierarchy ~~or variant of an R-tree~~.

19. (Original) The method according to claim 16, wherein the database comprises a spatial database.

20. (Currently amended) The method according to claim 16, wherein the first geometry and the second geometry comprise objects on a surface.

21. (Original) The method according to claim 20, wherein the database stores exact geometries and approximations of geometries.

22. (Currently amended) The method according to claim 50 ~~1~~, wherein determining whether the first geometry and the second geometry fulfill the secondary filter condition comprises mathematically comparing the fist geometry and the second geometry.

23. (Currently amended) The method according to claim 50 ~~1~~, wherein the secondary filter condition is fulfilled if the first geometry and the second geometry overlap.

24. (Currently amended) The method according to claim 50 ~~1~~, wherein the secondary filter condition is fulfilled if a boundary of the first geometry touches a boundary of the second geometry.

25. (Currently amended) The method according to claim 50 ~~1~~, wherein the secondary filter condition is fulfilled if the first geometry and the second geometry intersect.

26. (Currently amended) The method according to claim 48 ~~1~~, wherein at least one of the first geometry and the second geometry is convex.

27. (Original) The method according to claim 26, wherein at least one of the first geometry and the second geometry comprises a plurality of separate interiors.

28. (Currently amended) The method according to claim 48 ~~1~~, wherein at least one of the first geometry and the second geometry is concave.

29. (Currently amended) A method for determining relationships among objects represented in a database, the method comprising the steps of:

receiving a query including at least a first geometry and a desired relationship between the first geometry and a second geometry;

providing the query to a primary filter operable to;

define at least one interior geometric shape that lies entirely within the first

geometry;

define an approximation of the first geometry;

define an approximation of the second geometry; and

compare the approximation of the first geometry with the approximation of the second geometry to determine if the second geometry fulfills a primary filter condition comprising an interaction of the first geometry and the second geometry;

if the second geometry fulfills the primary filter condition, providing the first geometry and the second geometry to an intermediate filter operable to:

determine whether the second geometry fulfills an intermediate filter condition comprising an interaction of the first geometry and the second geometry by analyzing the distribution of the approximation of the second geometry with respect to the at least one interior ~~rectangle~~ geometric shape within the first geometry;

if the second geometry is confirmed as fulfilling the intermediate filter condition, including the second geometry in a final result set of objects that satisfy the desired relationship;

if the second geometry is confirmed as deviating from the intermediate filter condition, excluding the second geometry from the final result set that satisfy the desired relationship;

otherwise, providing the first geometry and the second geometry to a secondary filter operable to:

determine whether the second geometry fulfills a secondary filter condition by comparing the second geometry with the first geometry; and

if the second geometry fulfills the secondary filter condition, including the second geometry in the final result set of objects that satisfy the desired relationship.

30. (Currently amended) The method according to claim 52 ~~29~~, wherein at least one of the first geometry and the second geometry is convex.

31. (Original) The method according to claim 30, wherein at least one of the first geometry and the second geometry comprises a plurality of separate interiors.

32. (Currently amended) The method according to claim 52 ~~29~~, wherein at least one of the first geometry and the second geometry is concave.

33. (Original) The method according to claim 32, wherein concave geometries are approximated utilizing convex pieces.

34. (Original) The method according to claim 32, wherein concave geometries are approximated utilizing tiles.

35. (Original) The method according to claim 34, wherein a minimum bounding rectangle is tiled and tiles interior to the geometry are identified.

36. (Original) The method according to claim 34, wherein the tiling level is 5.

37. (Original) The method according to claim 34, wherein the tiling level is 4.

38. (Original) The method according to claim 34, wherein the tiling level is 3.

39. (Original) The method according to claim 34, wherein determining whether the primary filter condition is fulfilled comprises comparing interior tiles.

40. (Original) The method according to claim 32, wherein the approximation of the first geometry comprises a minimum bounding rectangle and the approximation of the second geometry comprises a minimum bounding rectangle and wherein comparing the interior tiles comprises:

dividing the second geometry minimum bounding rectangle into tiles;

assigning X and Y values to the tiles;

determining which tiles lie interior to the second geometry;

determining X and Y location of each tile;

storing the interior tiles in an array ordered first by X location;

storing the interior tiles in an array ordered first by Y location; and

comparing at least one of the tiles or the minimum bounding rectangle of the first geometry with the interior tiles of the second geometry to determine the relationships among the geometries.

41. (Original) The method according to claim 40, wherein comparing the minimum bounding rectangle of the first geometry with the interior tiles of the second geometry comprises determining whether each side of the minimum bounding rectangle of first geometry is inside the interior tiles of the second geometry which comprises:

determining X and Y locations within the tiles of corners of the minimum bounding rectangle of the first geometry;

determining X and Y locations within the tiles of second geometry for two corners of each side of the first geometry; and

determining whether all tiles between the two corners of each side of the first geometry are interior to the second geometry by comparing a difference in an x-location or a y-locations of the two corners to the number of interior tiles between these two corners.

42. (Original) The method according to claim 41, wherein whether the x-location or the y-location is compared depends upon whether the side is parallel to y-axis or x-axis.

43. (Original) The method according to claim 41, wherein the second geometry is not a simple polygon.

44. (Original) The method according to claim 40, wherein comparing the minimum bounding rectangle of the first geometry with the interior tiles of the second geometry comprises determining whether each side of the minimum bounding rectangle of first geometry is inside the interior tiles of the second geometry which comprises:

determining X and Y locations within the tiles of corners of the minimum bounding rectangle of the first geometry;

determining X and Y locations within the tiles of second geometry for two corners of line interior to the MBR of the first geometry; and

determining whether all tiles between the two corners any line interior to the MBR of the first geometry are interior to the second geometry by comparing a difference in an x-location or a y-locations of the two corners to the number of interior tiles between these two corners.

45. (Original) The method according to claim 41, wherein the second geometry is a compound geometry comprising multiple polygons or a geometry comprising holes, and wherein determining if the minimum bounding rectangle of the first geometry is interior to the interior tiles of second geometry by comparing the interior of the minimum bounding rectangle of first geometry to the interior tiles of second geometry.

46. (Currently amended) A computer program product for performing a process of determining relationships among objects represented in a database, comprising:

a computer readable medium; and

computer program instructions, recorded on the computer readable medium, executable by a processor, for performing the steps of:

receiving a query including at least a first geometry and a desired relationship between the first geometry and a second geometry;

providing the query to a primary filter operable to:

define at least one interior rectangle that lies entirely within the first geometry;

define a minimum bounding rectangle for the first geometry;

define a minimum bounding rectangle for the second geometry; and

compare the minimum bounding rectangle for the first geometry with the minimum bounding rectangle for the second geometry to determine if the second geometry fulfills a primary filter condition comprising an interaction of the first geometry and the second geometry;

if the second geometry fulfills the primary filter condition, providing the first geometry and the second geometry to an intermediate filter operable to:

determine whether the second geometry fulfills an intermediate filter condition comprising an interaction of the at least one interior rectangle within the first geometry and the minimum bounding rectangle for the second geometry by analyzing the distribution of the minimum bounding rectangle for the second geometry with respect to the at least one interior

rectangle within the first geometry;

if the second geometry is confirmed as fulfilling the intermediate filter condition, including the second geometry in a final result set of objects that satisfy the desired relationship;

if the second geometry is confirmed as deviating from the intermediate filter condition, excluding the second geometry from the final result set that satisfy the desired relationship;

otherwise, providing the first geometry and the second geometry to a secondary filter operable to:

determine whether the second geometry fulfills a secondary filter condition by comparing the second geometry with the first geometry; and

if the second geometry fulfills the secondary filter condition, including the second geometry in the final result set of objects that satisfy the desired relationship.

47. (Currently amended) A system for performing a process of determining relationships among objects represented in a database, comprising:

a processor operable to execute computer program instructions; and

a memory operable to store computer program instructions executable by the processor, for performing the steps of:

receiving a query including at least a first geometry and a desired relationship between the first geometry and a second geometry;

providing the query to a primary filter operable to:

define at least one interior rectangle that lies entirely within the first geometry;

define a minimum bounding rectangle for the first geometry;

define a minimum bounding rectangle for the second geometry; and

compare the minimum bounding rectangle for the first geometry with the minimum bounding rectangle for the second geometry to determine if the second geometry fulfills a primary filter condition comprising an interaction of the first geometry and the second geometry;

if the second geometry fulfills the primary filter condition, providing the first geometry and the second geometry to an intermediate filter operable to:

determine whether the second geometry fulfills an intermediate filter condition comprising an interaction of the at least one interior rectangle within the first geometry and the minimum bounding rectangle for the second geometry by analyzing the distribution of the minimum bounding rectangle for the second geometry with respect to the at least one interior rectangle within the first geometry;

if the second geometry is confirmed as fulfilling the intermediate filter condition, including the second geometry in a final result set of objects that satisfy the desired relationship;

if the second geometry is confirmed as deviating from the intermediate filter condition, excluding the second geometry from the final result set that satisfy the desired relationship;

otherwise, providing the first geometry and the second geometry to a secondary filter operable to:

determine whether the second geometry fulfills a secondary filter condition by comparing the second geometry with the first geometry; and

if the second geometry fulfills the secondary filter condition, including the second geometry in the final result set of objects that satisfy the desired relationship.

48. (New) A method for determining relationships among objects represented in a database, the method comprising the steps of:

receiving a query including at least a desired relationship between a first geometry and a second geometry;

defining at least one interior rectangle that lies entirely within the first geometry;

defining a minimum bounding rectangle for the first geometry;

defining a minimum bounding rectangle for the second geometry; and

providing the first geometry and the second geometry to an intermediate filter operable to:

determine whether the second geometry fulfills an intermediate filter condition comprising an interaction of the at least one interior rectangle that lies entirely within the first geometry and the minimum bounding rectangle for the second geometry by analyzing the distribution of the minimum bounding rectangle for the second geometry with respect to the at least one interior rectangle within the first geometry.

49. (New) A method according to claim 48, further comprising including the second geometry in a final result set of objects that satisfy the desired relationship if the second

geometry is confirmed as fulfilling the intermediate filter condition.

50. (New) A method according to claim 49, further comprising excluding the second geometry from the final result set that satisfy the desired relationship if the second geometry is confirmed as deviating from the intermediate filter condition.

51. (New) A method according to claim 50, further comprising providing the first geometry and the second geometry to a secondary filter operable to:

determine whether the second geometry fulfills a secondary filter condition by comparing the second geometry with the first geometry ; and

if the second geometry fulfills the secondary filter condition, including the second geometry in the final result set of objects that satisfy the desired relationship, otherwise excluding the second geometry from the final result set of objects that satisfy the desired relationship.

52. (New) A method for determining relationships among objects represented in a database, the method comprising the steps of:

receiving a query including at least a desired relationship between a first geometry and a second geometry;

defining at least one interior rectangle that lies entirely within the first geometry;

defining an approximation for the first geometry;

defining an approximation for the second geometry; and

providing the first geometry and the second geometry to an intermediate filter operable to:

determine whether the second geometry fulfills an intermediate filter condition comprising an interaction of the at least one interior rectangle that lies entirely within the first geometry and the approximation for the second geometry by analyzing the distribution of the approximation for the second geometry with respect to the at least one interior rectangle within the first geometry.

53. (New) A method according to claim 52, further comprising including the second geometry in a final result set of objects that satisfy the desired relationship if the second geometry is confirmed as fulfilling the intermediate filter condition.

54. (New) A method according to claim 53, further comprising excluding the second geometry from the final result set that satisfy the desired relationship if the second geometry is confirmed as deviating from the intermediate filter condition.

55. (New) A method according to claim 54, further comprising providing the first geometry and the second geometry to a secondary filter operable to:

determine whether the second geometry fulfills a secondary filter condition by comparing the second geometry with the first geometry ; and

if the second geometry fulfills the secondary filter condition, including the second geometry in the final result set of objects that satisfy the desired relationship,

otherwise excluding the second geometry from the final result set of objects that satisfy the desired relationship.

56. (New) A system for performing a process of determining relationships among objects represented in a database, comprising:

a processor operable to execute computer program instructions; and

a memory operable to store computer program instructions executable by the processor, for performing the steps of:

receiving a query including at least a desired relationship between a first geometry and a second geometry;

defining at least one interior rectangle that lies entirely within the first geometry;

defining a minimum bounding rectangle for the first geometry;

defining a minimum bounding rectangle for the second geometry; and

providing the first geometry and the second geometry to an intermediate filter operable to:

determine whether the second geometry fulfills an intermediate filter condition comprising an interaction of the at least one interior rectangle that lies entirely within the first geometry and the minimum bounding rectangle for the second geometry by analyzing the distribution of the minimum bounding rectangle for the second geometry with respect to the at least one interior rectangle within the first geometry.

57. (Currently amended) A computer program product for performing a process of determining relationships among objects represented in a database, comprising:

a computer readable medium; and

computer program instructions, recorded on the computer readable medium, executable by a processor, for performing the steps of:

receiving a query including at least a desired relationship between a first geometry and a second geometry;

defining at least one interior rectangle that lies entirely within the first geometry;

defining a minimum bounding rectangle for the first geometry;

defining a minimum bounding rectangle for the second geometry; and

providing the first geometry and the second geometry to an intermediate filter operable to:

determine whether the second geometry fulfills an intermediate filter condition comprising an interaction of the at least one interior rectangle that lies entirely within the first geometry and the minimum bounding rectangle for the second geometry by analyzing the distribution of the minimum bounding rectangle for the second.